

# Notice of Allowability

Application No.

09/784,952

Examiner

Kevin M Bernatz

Applicant(s)

ONO ET AL.

Art Unit

1773

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to interview of 4/26/05.
2. ☒ The allowed claim(s) is/are 1,8 and 11-16.
3. ☒ The drawings filed on 16 February 2001 are accepted by the Examiner.
4. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
  - a) ☒ All b) ☐ Some\* c) ☐ None of the:
    1. ☒ Certified copies of the priority documents have been received.
    2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
    3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
  - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
    - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date \_\_\_\_\_.
  - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_\_.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

## Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date \_\_\_\_\_
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☒ Interview Summary (PTO-413), Paper No./Mail Date 04272005.
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other \_\_\_\_\_.

***Examiner's Amendment***

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

- The title has been amended as follows: after "Medium", the following phrase/word was inserted: "Utilizing a DLC Protective Layer With Surface Functional Groups".

2. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

3. Authorization for this examiner's amendment was given in a telephone interview with Mr. David Zibelli on April 26, 2005.

The application has been amended as follows:

- Claim 1, line 3: before "functional", the word "surface" was inserted;
  - Claim 1, line 3: the phrase "having N atoms" was deleted;
  - Claim 1, line 4: after "composed of carbon", the following phrase was inserted: "and further including Nitrogen atoms";
  - Claim 1, line 4: the phrase "exceeds 20%" was replaced with "is between 23% and 38%, inclusive";

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- Claim 1, line 5: before “functional”, the word “additional” was inserted;  
and
  - Claim 1, line 6: after “coating”, the following phrase was inserted: “,  
wherein the surface functional groups include –COOH, –C=O, –COH,  
and –CNH<sub>2</sub>, and mixtures thereof”.
- Claims 2 – 7 were cancelled;
- Claim 8, line 3: before “functional”, the word “surface” was inserted;
  - Claim 8, line 3: the phrase “having N atoms” was deleted;
  - Claim 8, line 4: after “composed of carbon”, the following phrase was  
inserted: “and further including Nitrogen atoms”;
  - Claim 8, line 5: the phrase “exceeds 20%” was replaced with “is  
between 23% and 38%, inclusive”;
  - Claim 8, line 6: before “functional”, the word “additional” was inserted;  
and
  - Claim 8, line 6: after “coating”, the following phrase was inserted: “,  
wherein the surface functional groups include –COOH, –C=O, –COH,  
and –CNH<sub>2</sub>, and mixtures thereof”.
- Claim 11, line 3: before “functional”, the word “surface” was inserted;
  - Claim 11, line 3: the phrase “having N atoms” was deleted;
  - Claim 11, line 4: after “composed of carbon”, the following phrase was  
inserted: “and further including Nitrogen atoms”;

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- Claim 11, lines 4 - 5: the phrase "exceeds 20%" was replaced with "is between 23% and 38%, inclusive";
- Claim 11, line 5: before "functional", the word "additional" was inserted; and
- Claim 11, line 6: after "coating", the following phrase was inserted: ", wherein the surface functional groups include -COOH, -C=O, -COH, and -CNH<sub>2</sub>, and mixtures thereof".
- Claim 13, line 3: before "functional", the word "surface" was inserted;
  - Claim 13, line 8: after "composed of carbon", the following phrase was inserted: "and further including Nitrogen atoms";
  - Claim 13, line 13: before "functional groups", the word "surface" was inserted;
  - Claim 13, line 13: the phrase "having N atoms" was deleted; and
  - Claim 13, line 14: the phrase "exceeds 20%" was replaced with "is between 23% and 38%, inclusive, wherein the surface functional groups include -COOH, -C=O, -COH, and -CNH<sub>2</sub>, and mixtures thereof".
- Claim 14, line 3: the phrase "mainly composed of Cr" was deleted;
  - Claim 14, line 3: before "functional groups", the word "surface" was inserted;
  - Claim 14, lines 3 - 4: the phrase "composed of at least one of the -COOH, -C=O, -COH, and -NH<sub>2</sub>" was deleted;

- Claim 14, line 5: after “protective”, the word “layer” was inserted;
- Claim 14, line 5: after “composed of carbon”, the following phrase was inserted: “and further including Nitrogen atoms”;
- Claim 14, line 5: the phrase “exceeds 20%” was replaced with “is between 23% and 38%, inclusive”; and
- Claim 14, line 6, before “functional”, the phrase “of the” was replaced with the word “additional”;
- Claim 14, line 6, after “group”, the following phrase was inserted: “, wherein the surface functional groups include –COOH, –C=O, –COH, and –CNH<sub>2</sub>, and mixtures thereof”.

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#### ***Reasons for Allowance***

4. The present claims are deemed allowable over the closest prior art since the closest prior art fails to disclose or render obvious the unexpected results shown by applicants for a diamond-like carbon (DLC) protective layer including nitrogen atoms, wherein the percentage of specific surface functional groups are controlled to be within the range of 23 – 38 % per 100 carbon atoms.

The Examiner notes that the prior art recognizes that nitrogen can be added to DLC protective layers for improving the mechanical characteristics of these films, as well as for improved lubricant adhesion (see Examiner’s comments below).

Furthermore, the Examiner notes that the prior art recognizes that lubricant adhesion or “spin-off” is a known problem associated with DLC films, and that improved lubricant

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adhesion can be achieved by functionalizing the lubricant in order to "bond" with surface characteristics of a treated DLC film (see Examiner's comments below).

However, the prior art fails to teach or render obvious the unexpected results shown by applicants for a DLC film further comprising Nitrogen atoms, wherein the surface of the DLC protective film is controlled to possess 23 – 38% of *specific surface* functional groups, said *specific* functional groups being selected from –COOH, –C=O, –COH and –CNH<sub>2</sub> groups.

5. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

#### ***Examiner's Comments***

6. In order to better clarify the record, the examiner wishes to point out the following references which provide evidence for the state of the art with regard to DLC protective layers and "functionalized" lubricants. Ruhe et al. (J. App. Poly. Sci., 53(1994), 825 – 836, Titled: "Terminal Attachment of Perfluorinated Polymers to Solid Surfaces") describe the difficulty in achieving good bonding between DLC surfaces and fluorinated lubricants. Ruhe et al. further disclose a substantially identical method for measuring the concentration of functional groups on the carbon surface (i.e. tagging with a fluorinated compound), reports a wide range of surface functional group percentages for non-Nitrogen containing DLC films, and mentions that "the surface chemistry did

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depend very strongly on the sputtering conditions. Even in materials sputtered under nearly identical conditions ... significant fluctuations in the number of surface hydroxyl versus surface carboxyl groups were observed" (*page 828 of paper*).

Several references teach adding Nitrogen to DLC films. Honda et al. (U.S. Patent No. 6,706,363 B2) teach controlling the amount of Nitrogen added to a DLC film, as well as adding the Nitrogen primarily to the surface of the film for improving the adhesion of the lubricant, but makes no mention of surface functional group types or concentrations. Usuki et al. (U.S. Patent No. 6,740,407 B1) teach adding 5 – 8 atomic % Nitrogen to a DLC film further containing Hydrogen, but makes no mention of surface functional group types or concentrations. Katayama et al. (U.S. Patent No. 6,391,419 B1) mention adding Nitrogen and/or Hydrogen to a DLC film and that the adhesion with the lubricant can be improved by surface treating the film with oxygen, but makes no mention of types of surface functional groups, nor concentrations. Kokaku et al. (U.S. Patent No. 6,329,037 B1) teach controlling the Nitrogen content in a laminate-type protective layer in order to control the surface strength, but also report that the amount of lubricant lost due to spin-off is ~5% or less, however Kokaku et al. makes no mention of surface functional group types or concentrations.

Several references are directed to functionalize lubricants, but none of these references are directed to nitrogen containing DLC layers. The Examiner notes that the prior art cited above provides evidence that adding Nitrogen to a DLC film substantially affects the surface properties and characteristics of the protective layer. Tei et al. (U.S. Patent No. 6,096,694) teach a DLC protective film with carbonyl, carboxyl and hydroxyl

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surface groups for bonding a functionalize lubricant to the surface. Tei et al. further disclose that at least 30% of the used lubricant should be the aforementioned “bonded” lubricant, but fails to relate how the “bonded” lubricant molecules correlate to the functionalized surface groups. The Examiner notes that given the known effects of packing density and entanglement associated with polymeric compounds, it is deemed extremely unlikely that the amount of “surface functional groups” correlates with the amount of “bonded lubricant” in a one-to-one basis. Yanagisaw (U.S. Patent No. 5,858,536) teach bonding a fluorinated lubricant directly to exposed free carbon adsorption sites, but makes no mention of surface functional groups meeting applicants’ claimed composition or concentration limitations.

Finally, several references are directed to solving similar problems of “spin-off” of lubricant, but solve the problem via different methods. Akada et al. (U.S. Patent No. 6,541,431 B1) teach controlling the type of lubricant inorder to achieve good bonding with hydrogen or nitrogen atoms on the surface of a DLC protective layer, but makes no mention of the surface functional group concentration or types, other than that they contain hydrogen and/or nitrogen. Furutani et al. (U.S. Patent No. 5,962,117) similarly teach controlling the type of lubricant to achieve good adhesion with a DLC film, but further teach cleaning the surface of the protective layer with an oxygen or ammonia plasma prior to lubricant deposition for improved adhesion characteristics. However, Furutani et al. fail to mention adding nitrogen atoms to the DLC film, nor the concentration of surface functional groups.



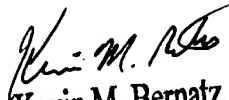
**Conclusion**

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kevin M Bernatz whose telephone number is (571) 272-1505. The examiner can normally be reached on M-F, 9:00 AM - 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carol Chaney can be reached on (571) 272-1284. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

KMB  
April 27, 2005

  
Kevin M. Bernatz, PhD  
Primary Examiner